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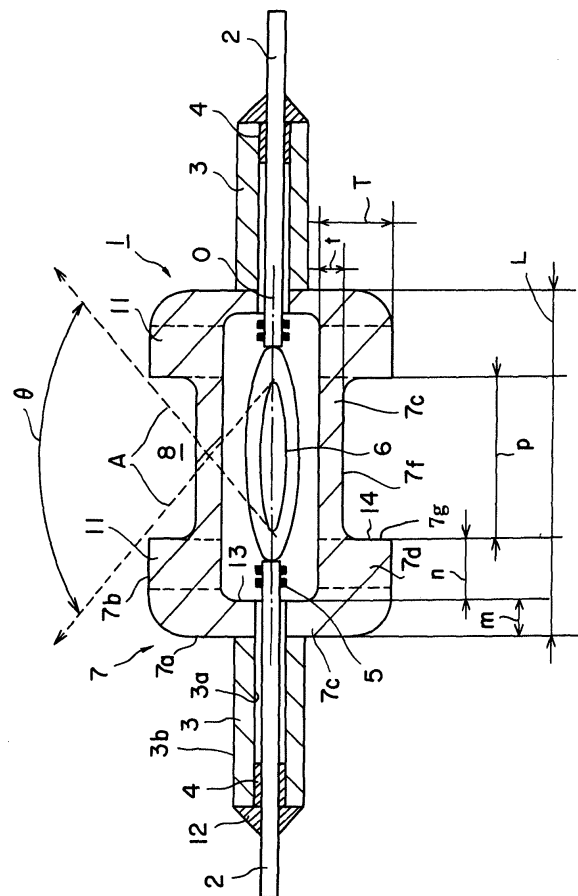
(54) **Luminous vessels for high luminance discharge lamps**

(57) An object of the present invention is to improve the color temperature stability of light emission and maintain durability when repeating light-on and light-off, while narrowing light emission from the light-emitting vessel.

A light-emitting container 1 for a high intensity discharge lamp includes:

a light-emitting vessel 7 of a translucent polycrystalline ceramics having a substantially constant linear transmittance in a visible light region and having a central light-emitting portion 7e, thick portions 7d provided on both sides of the central light-emitting portion 7e and thicker than the central light-emitting portion 7e, respectively, and side end portions 7c provided on outer sides of the thick portions 7d, respectively;
tubular portions 3 protruded from the side end portions, respectively;
electrodes 5 provided in the inner space of the light-emitting vessel;
electrode holding members 2 inserted through the tubular portions and holding the electrodes, respectively;
a sealing material 4 sealing a space between the tubular portion and electrode holding member; and
light-shielding films 11 for coating the outer surface 7b of the thick portions over full-circumference around a tube axis of the light-emitting vessel. The outer surfaces of the central light-emitting portion 7e, the side end portions 7c and the tubular portions 3 are not coated with the light-shielding film.

Fig. 1



Description

FIELD OF THE INVENTION

[0001] The present invention relates to a light-emitting container for high intensity discharge lamp.

BACKGROUND ART

[0002] Since translucent ceramics transmits visible light therethrough, they have been used as a light-emitting container for a high intensity discharge lamp. Particularly, translucent alumina ceramics is used as a light-emitting container for a high intensity discharge lamp.

[0003] To improve color temperature stability of a ceramic metal halide lamp, it is necessary to raise the vapor pressure of metal halide in plasma arc. It is disclosed that metal halide vapor pressure is improved by coating a part of ceramic tube with zirconium oxide, and reflecting infrared ray radiated from the plasma arc into the light-emitting vessel to raise temperature inside the light-emitting vessel (European Patent No. 0869540A1: Japanese Patent Laid-Open Publication No. H10-335059A). In European Patent No. 0869540A1: Japanese Patent Laid-Open Publication No. H10-335059A, liquefaction and temperature reduction of metal halide filling is prevented, and good color rendering properties are secured by coating both end surfaces (end plugs) of the light-emitting vessel and the surface of an elongated tubular portion (leg portion) attached to the light-emitting vessel with zirconium oxide film.

[0004] Further, to prevent color temperature or light emission efficiency of a metal halide lamp, in which volume of the light-emitting vessel is less than 1cc and power consumption is 150W or less, from being changed by lighting direction, applying thermal reflection coating to the both ends of the light-emitting vessel is disclosed (U.S. Patent No. 5708328B).

[0005] Further, in a high-pressure discharge lamp for automobile headlight in which a light-emitting portion having average linear transmittance of visible light of 15% or more and a plug end portion having the linear transmittance of less than 15% were fabricated by a shrink fit method, blocking of light radiation in an undesired direction by further forming a light-shielding film on the surface of the light-emitting vessel is described in Japanese Patent Laid-open Publication No. 2006-93045A (paragraph 0054).

[0006] Further, Japanese Patent Laid-Open Publication No. 2004-6198A describes the high-pressure discharge lamp for automobile headlight, in which the central portion of the light-emitting vessel is made thinner to dispose a luminance center at the central portion, and condensing efficiency of projected beam to a focal point is improved.

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007] In a high intensity discharge lamp, electric discharge between electrodes is first generated in starting gas such as mercury vapor and argon gas, sodium or metal iodide being a light-emitting material is vaporized and gasified by utilizing thermal energy caused by the discharge energy, the light-emitting material is further excited by the energy of electrons discharging between electrodes, and light that is generated when electrons of the light-emitting material return from an excited state to a ground state is utilized as a light source.

[0008] For this reason, the higher the vapor pressure of the light-emitting material becomes, the higher the probability of collision between the discharging electrons and the light-emitting material gets, and excitation of the light-emitting material can be easily occurred and light emission efficiency increases. To increase the vapor pressure of the light-emitting material, it is necessary to raise the temperature of the light-emitting material, and it is important to hold gas temperature inside the light-emitting vessel at a high level for that purpose.

[0009] Light emission is generated by utilizing electric discharge between electrodes in the high intensity discharge lamp as described, temperature of a light emitting area becomes the highest and temperature of the base of electrodes and the rear portions of the electrodes becomes lower. The lowest temperature area is called the coolest point, and since the vapor pressure of the light-emitting material inside the lamp is controlled by the coolest point, raising the temperature of the coolest point is important in increasing the vapor pressure of the light-emitting material.

[0010] To increase the temperature of the coolest point, providing a light-shielding film on an end plug of electrode base and the surface of a ring portion (leg portion) is effective as in prior arts (European Patent No. 0869540A1: Japanese Patent Laid-Open Publication No. H10-335059A: U.S. Patent No. 5708328B). As a result, the temperature of metal halide vapor is raised to increase the vapor pressure of the light-emitting material such as metal halide, light emission efficiency (lm/W) is improved, and at the same time, it becomes possible to provide a light-emitting vessel for high intensity discharge lamp with good color temperature stability.

[0011] Further, since the ceramic light-emitting vessel is generally translucent but not transparent, the entire light-emitting vessel emits light by light created and emitted by a plasma arc, and the size of a light source becomes the same as the size of the light-emitting vessel. For this reason, it is difficult to control a light-emitting region according to the performance of lighting equipment used in combination with the light-emitting vessel. In a lamp where a relatively large light source size is accepted such as a lamp for general illumination use, a light source size being larger compared to lighting equip-

ment does not become a serious problem. But the light source size of the ceramic light-emitting vessel is too large as a headlight for automobile or a lamp for projector, and combination with lighting equipment is difficult.

[0012] Further, it is also known that the condensing efficiency of projected beam is enhanced by emitting light from a narrow area at the central portion of the light-emitting vessel (Japanese Patent Laid-Open Publication No. 2006-93045A; Japanese Patent Laid-Open Publication No. 2004-6198A). As described in these documents, it is effective to make both end portions of the light-emitting vessel thicker and form light-shielding film on both end portions to increase the temperature of the coolest point consequently.

[0013] However, the present inventor, as a result of prototyping and examining a large number of high-pressure discharge lamps of the above-described concept, has discovered that there is rather inconvenience in the point of color temperature stability, durability when repeating light-on or the like, unlike conventional common knowledge.

[0014] Specifically, by coating end plugs and tubular portions of the light-emitting vessel with the light-shielding film and making a central light-emitting portion of the light-emitting vessel thinner, a luminance center can be arranged at the central light-emitting portion. In addition, the light and thermal radiation from the end plugs and the tubular portions are suppressed from the both sides of the central light-emitting portion to prevent accumulation or liquefaction of gas at the coolest point, and color temperature stability should have been improved.

[0015] However, it has been found out that, when such a light-emitting vessel is actually fabricated, the color temperature stability is deteriorated, and durability when repeating light-on and light-off is reduced.

[0016] An object of the present invention is to improve the color temperature stability of light emission and maintain durability when repeating light-on and light-off, while narrowing light emission from the light-emitting vessel.

MEANS FOR SOLVING THE PROBLEMS

[0017] A light-emitting container for a high intensity discharge lamp of the present invention comprises:

a light-emitting vessel comprising a translucent polycrystalline ceramics having a substantially constant linear transmittance in a visible light region, the light-emitting vessel comprising a central light-emitting portion, thick portions provided on both sides of the central light-emitting portion and thicker than the central light-emitting portion, respectively, and side end portions provided on outer sides of the thick portions, respectively;
tubular portions protruded from the side end portions, respectively;
electrodes provided in the inner space of the light-emitting vessel;

electrode holding members inserted through the tubular portions and holding the electrodes, respectively;

a sealing material sealing a space between the tubular portion and electrode holding member; and
light-shielding films for coating the outer surface of the thick portions over full-circumference around a tube axis of the light-emitting vessel,
wherein the outer surfaces of the central light-emitting portion, the side end portions and the tubular portions are not coated with the light-shielding film.

EFFECT OF THE INVENTION

[0018] According to the present invention, condensing efficiency to projected beam can be increased by making the central light-emitting portion of the light-emitting vessel relatively thinner and arranging a luminance center there. At this point, by providing the light-shielding film for coating the outer surface of the thick portions at the both sides of the central light-emitting portion over full-circumference around the tube axis of the light-emitting vessel, light emission can be concentrated on the central light-emitting portion.

[0019] At the same time, it has been found out that liquefaction or temperature drop of gas at the coolest point of the light-emitting vessel can be appropriately controlled by making the both sides of the central light-emitting portion thicker and providing the light-shielding film for them. At this point, the sealing material was deteriorated due to temperature rise of the sealing material when the outer surface of the side end portions and tubular portions were coated with the light-shielding film, and as a result, color temperature stability was reduced and durability when repeating light-on and light-off was reduced. This is considered that gas temperature at the end plugs rises higher than expected, and corrosive gas flowed into the tubular portion to easily corrode a sealed area.

[0020] Then, in the present invention, the outer surface of the side end portions and the tubular portion is designed not to be coated with the light-shielding film. Then, color temperature stability is remarkably improved and durability when repeating light-on and light-off is also improved. The object of the prior arts is to obtain color temperature stability by coating the surface of the side end portions and the tubular portions with the light-shielding film.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a sectional view schematically showing a light-emitting container 1 according to an embodiment of the present invention.

FIG. 2 is a front view showing an appearance of the container 1 of FIG. 1.

MODES FOR CARRYING OUT THE INVENTION

[0022] FIG. 1 is a schematic sectional view of the light-emitting container for high intensity discharge lamp 1 used in a metal halide lamp, and FIG. 2 is a front view showing an appearance of the container 1.

[0023] A light-emitting vessel 7 of the light-emitting container 1 includes a central light-emitting portion 7e, thick portions 7d on the both sides of the central light-emitting portion 7e, and side end portions 7c on the outer side of each thick portion 7d. The central light-emitting portion 7e is depressed from outside to the thick portions 7d in this example, and the inner surface of the central light-emitting portion and the inner surface of the thick portion are smoothly continued.

[0024] A tubular portion (leg portion) 3 is attached to the outer side of each side end portion. An electrode holding member 2 is inserted through an inner space 3a of the tubular portion 3, and an electrode 5 is attached to an inner end of the electrode holding member 2. An outer end portion of the electrode holding member 2 is sealed against an inner wall surface of the tubular portion 3 by a sealing material 4, and further sealed against the outer end surface of the tubular portion 3 by a sealing material 12. A pair of the electrodes 5 are positioned in the inner space of the light-emitting vessel 7, and designed such that electric discharge can be generated between the electrodes 5.

[0025] The thick portion means having thickness larger than the thickness of the central light-emitting portion, and in the present invention, the thick portions are formed on the both sides of the central light-emitting portion. The thickness t of the central light-emitting portion 7e is smaller than the thickness T of the thick portions 7d.

[0026] In an embodiment of FIG. 1, an outer surface 7f of the central light-emitting portion 7e is depressed from an outer surface 7b of each thick portion 7d, and thus the thickness of the central light-emitting portion is relatively small. An inner wall surface of the central light-emitting portion 7e and an inner wall surface of each thick portion 7d are smoothly continued and do not have a step. However, the inner wall surface of the central light-emitting portion 7e can be depressed from the inner wall surface of each thick portion 7d.

[0027] The outer surface 7b of each thick portion 7d is coated with a light-shielding film 11. The light-shielding film 11 coats the outer surface 7b of the thick portion so as to go around the light-emitting vessel assigning the tube axis O of the light-emitting vessel as a center. The surface of a step side surface 7g between each thick portion 7d and the central light-emitting portion may be also coated with the light-shielding film 11. The outer surface 7f of the central light-emitting portion 7e, an outer surface 7a of each side end portion 7c and an outer surface 3b of each tubular portion 3 are not coated with the light-shielding film.

[0028] By making the central light-emitting portion 7e thinner without providing the light-shielding film, and

coating the thick portions 7d on the both sides with the light-shielding film 11, a projection range of light from a light emission area 6 of a plasma arc is limited within the region of a projection angle θ . The projection range is smaller than a total length L of the light-emitting vessel 7.

[0029] Since the ceramic light-emitting vessel is translucent but not transparent, the entire light-emitting vessel emits light by light created and emitted by the plasma arc, and the size of a light source becomes the same as the size of the light-emitting vessel. For this reason, in a headlight for automobile or a light source lamp of a projector in which a small light source size is required, it is difficult to realize a light source size suitable for the performance of lighting equipment. However, according to the present invention, it becomes possible to provide a lamp suitable for the performance of lighting equipment by limiting a light source size to a predetermined size.

[0030] In the light-emitting vessel for automobile, for example, a translucent portion is made smaller, and a light source size can be the size of $2\text{ mm } \phi \times 4\text{ mm}$ which is equal to the filament size of a halogen lamp. Furthermore, to apply for the light source for projector, the light source size can be 1 mm or less in diameter.

[0031] The high-pressure discharge lamp of the present invention can be applied for other illumination devices to which pseudo point light source is applicable, such as a headlight for automobile, an OHP (overhead projector) and a liquid crystal projector.

[0032] In the present invention, the central light-emitting portion means a relatively small thickness area of the light-emitting vessel 7, which is sandwiched between the thick portions on the both sides. Further, the thick portions are areas between the central light-emitting portion and the side end portions. Specifically, as shown in FIG. 1, an area between an inner wall surface 13 of the side end portion 7b and the step 14 to the central light-emitting portion should be the thick portion. Further, the side end portion means a plate-shaped area that plugs up the both ends of the light-emitting vessel.

[0033] In the discharge lamp of the present invention, it is preferable that a ratio of a length p of the central light-emitting portion to the total length L of the light-emitting vessel 7 be 90% to 5%, and more preferably, 60% to 10% from the viewpoint of obtaining a light source of an appropriate size.

[0034] Further, it is preferable that a ratio of the surfaces 7b or 7g of the thick portion occupied by the light-shielding film be 30% or more, and more preferably, 50% or more from the viewpoint of the present invention. The light-shielding film may coat the entire outer surface of each thick portion.

Further, it is preferable that the light-shielding film coat 20% or more and 95% or less of the surface area of the outer surface of the light-emitting vessel.

[0035] From the viewpoint of increasing light emission quantity, it is preferable that the thickness t of the central light-emitting portion be 1.5 mm or less, and more preferably, 1.0 mm or less. Further, it is preferable that the

thickness t of the central light-emitting portion be 0.3 mm or more from the viewpoint of mechanical strength.

[0036] It is preferable that the thickness T of the thick portion be 0.5 mm or more from the viewpoint of color temperature stability, and more preferably, 1.0 mm or more. However, if the thickness T of the thick portion exceeds 5 mm, thermal stress during light-on is increased to reduce the reliability of the light-emitting vessel, so that the thickness T is preferably 5 mm or less.

[0037] It is preferable that, when the thickness t of the central light-emitting portion is set to 1, a ratio of the thickness T of the thick portion be 1.1 or more, and more preferably 1.5 or more, from the viewpoint of the present invention. Further, it is preferable that, when the thickness t of the central light-emitting portion is set to 1, the ratio of the thickness T of the thick portion be 10 or less, and more preferably 5 or less, from the viewpoint of avoiding stress concentration to the step area.

[0038] To make the thickness of the light-emitting vessel partially thicker, it is possible to make the thick portions thicker than the translucent portion by forming a thick difference by devising the inside and outside die shapes or making the thickness of an area corresponding to the translucent portion thinner by machining from outside. Regarding the machining to make the thickness thinner, it is easier to perform in the state of molded body before sintering (Green Machining) than performing after sintering.

[0039] Although the linear transmittance of the light-shielding film may be 3% or less, and more preferably, 1% or less. Further, for a material of the light-shielding film, a dark-colored coating material that absorbs light is desirable. Further, since the temperature of the light-emitting vessel could reach approximately 1000°C during use, it is desirable that the material has excellent heat resistance. Furthermore, it is necessary that the material be a material having a thermal expansion coefficient close to that of the light-emitting vessel. As a material that satisfies such characteristics, a cermet material consisting of refractory metal such as tungsten and molybdenum and a ceramic material such as alumina is preferable as a coating material of the thick portion.

[0040] It is preferable that the thickness of the coating material be 3 μm or more to obtain sufficient light-shielding performance. Further, if the thickness exceeds 10 μm , it is too thick due to mismatch of thermal expansion and the material can be easily peeled from the light-emitting vessel. The cermet material is transformed into a paste-state, and then coated on the outside surface of the light-emitting vessel after temporary sintering by a screen printing method or the like at a predetermined position and thickness, and a coating film can be formed on the light-emitting vessel surface by hydrogen atmosphere baking after drying.

[0041] The followings can be exemplified as semi-transparent translucent ceramics that constitute the light-emitting vessel: polycrystal Al_2O_3 , AlN and AlON or single crystal Al_2O_3 , YAG and Y_2O_3 having the surface rough-

ness of $R_a \geq 1.0 \mu\text{m}$.

[0042] Further, semi-transparent means the following light transmittance: total light transmittance of 85% or more and linear transmittance of 45% or less.

5 The luminance center means an area having the highest luminance in the light-emitting portion. It is not necessary that the luminance center be one point, but may extend in a direction of vertical section.

10 **[0043]** A high intensity discharge lamp means a mercury lamp using mercury as the light-emitting material, a high-pressure sodium lamp using sodium as the light-emitting material, and a metal halide lamp using metal iodide as the light-emitting material.

15 **[0044]** Polycrystal ceramics are molded by a molding method such as extrusion molding suitable for a desired shape, press molding such as dry-bag pressing, cast molding, injection molding, and gel cast molding.

EXAMPLES

20 (Example 1)

[0045] By using material powder for translucent alumina, a molded body of a light-emitting container for high intensity discharge lamp, which is used for the metal halide lamp shown in FIG. 1 and FIG. 2, was manufactured by the gel cast molding method. In the molded body, the diameter and thickness of the central light-emitting portion 7e were set to 3.9 mm and 0.7 mm, respectively, and the thickness of each thick portion 7d was set to 1.7 mm. The thickness of the tubular portion 3 was set to 0.5 mm, and the thickness of the side end portion was set to 1.3 mm.

35 **[0046]** In molding, an outer die and an inner die were prepared, slurry for gel cast molding was cast into a gap formed between the outer die and the inner die, and released from the dies after curing. The surface roughness of the metal mold was $R_a = 0.1 \mu\text{m}$ evenly. A male molded body and a female molded body obtained were baked in the atmosphere of 1300°C in a fitted state, binder was removed and the bodies were temporary baked into a unified body. Then, paste made of tungsten powder and alumina powder was coated on an area corresponding to the thick portion of the unified temporarily baked body by a screen printing method and then dried. The alumina temporary-sintered body was baked in the hydrogen atmosphere of 1800°C for three hours, and the light-emitting container 1 made of translucent polycrystal alumina ceramics was manufactured.

50 **[0047]** The average grain diameter of the crystal of the light-emitting container 1 after sintering is 25 μm . The thickness of the tubular portion 3 is 0.4 mm. The total length L of the light-emitting vessel 7 is 10 mm, the diameter of the central light-emitting portion 7e is 3 mm, the length p is 4 mm, and the thickness t is 0.5 mm. The length n and the thickness T of the thick portion 7b are 2 mm and 1.3 mm, respectively. On the surface of thick portions, the light-shielding film 11 made of tungsten-alu-

mina cermet and having a thickness of 5 μm was formed. The linear transmittance of the light-shielding film 11 is 2% or less. The light-shielding film 11 coats 100% of step surface 7g between the outer surface 7b of each thick portion 7d and the central light-emitting portion.

[0048] The electrode holding member 2, which was formed by joining the electrodes 5 including a coil portion made of tungsten to an introducing conductor portion made of niobium via molybdenum, was inserted into one tubular portion 3 of the light-emitting container 1. The position of a joint portion between the introducing conductor portion and molybdenum was temporarily fixed by a jig such that the introducing conductor comes outside a capillary in the vicinity of a capillary end portion. After a ring-shaped sealing frit material was inserted from the introducing conductor and placed on the capillary end portion, the area was heated and melted to a predetermined temperature and air-tightly sealed.

[0049] Furthermore, in a glove box of argon atmosphere, an appropriate amount of mercury and iodide of Na, Tl and Dy as a light emission metal was put into a composite light-emitting container, in which one end portion was air-tightly sealed, from the other capillary side that is not sealed. Then, in the same manner as above, a metal component, which was formed by joining the electrode portions including the coil portion made of tungsten to the introducing conductor portion made of niobium via molybdenum, was inserted into the container, the positions of the joint portion between the introducing conductor portion and molybdenum was temporarily fixed by the jig such that the introducing conductor comes outside a capillary in the vicinity of the capillary end portion. After the ring-shaped sealing frit material was inserted from the introducing conductor and placed on the capillary end portion, the area was heated and melted to a predetermined temperature and air-tightly sealed.

[0050] FIG. 1 shows the sectional view of the light-emitting vessel during light-on. With the light-emitting vessel, it becomes possible to realize a light-emitting vessel size smaller than the size of a conventional ceramic light-emitting vessel.

[0051] The following test was conducted to the obtained discharge lamp. Test methods and results are shown.

Lead wire for supplying current was welded to the electrode holding member of the discharge lamp, and inserted into a glass outer sphere to make a lamp. Current was flown by utilizing a predetermined ballast power supply, and the lamp could be turned on as a metal halide high-pressure discharge lamp.

(Color stability)

[0052] Color stability of the lamp was evaluated by evaluating time dependency of color rendering properties. The lamp indicated color rendering properties index Ra85 at the initial state, and indicated a substantially equal value of color rendering properties index 83 even

after 1,000 hours of lighting test. Further, lamp light emission efficiency that was simultaneously evaluated was 90 lm/W at the initial state and maintained substantially equal lamp light emission efficiency of 88 lm/W after 1,000 hours of lighting test.

(Light-on/light-off durability)

[0053] Durability of the lamp was evaluated by repeating light-on/light-off and confirming changes of the light emission efficiency of the lamp. The lamp light emission efficiency after 1,000 cycles of light-on/light-off test was 85 lm/W comparing to the initial lamp light emission efficiency of 90 lm/W, which was maintained at substantially equal lamp light emission efficiency after the light-on/light-off test.

(Comparative Example 1)

[0054] In Example 1, the outer surface 7a of each side end portion 7c and the outer surface 3b of each tubular portion 3 were coated with the light-shielding film 11 in addition to the outer surface 7b of each thick portion 7d. Test results are shown below.

(Color stability)

[0055] Color stability of the lamp was evaluated by evaluating the time dependency of color rendering properties similarly to the Example. The lamp indicated color rendering properties index Ra85 at the initial state. The color rendering properties index is reduced to 60 after 400 hours, and the lamp became light-out at 500 hours.

(Light-on/light-off durability)

[0056] Durability of the lamp was evaluated by repeating light-on/light-off and confirming changes of the light emission efficiency of the lamp similarly to the Example. The lamp light emission efficiency after 300 cycles of light-on/light-off test was deteriorated to 50 lm/W comparing to the initial lamp light emission efficiency of 90 lm/W, and the lamp became light-out at 350th cycle.

Claims

1. A light-emitting container for a high intensity discharge lamp, the container comprising:

a light-emitting vessel comprising a translucent polycrystalline ceramics, said light-emitting vessel comprising a central light-emitting portion, thick portions provided on both sides of the central light-emitting portion, respectively, and thicker than the central light-emitting portion, and side end portions provided on outer sides of the thick portions, respectively;

tubular portions protruded from the side end portions, respectively;

electrodes provided in an inner space of the light-emitting vessel;

electrode holding members inserted through the tubular portions and holding the electrodes, respectively;

a sealing material sealing a space between the tubular portion and the electrode holding member; and

a light-shielding film coating an outer surface of the thick portion over full-circumference around a tube axis of the light-emitting vessel, wherein outer surfaces of the central light-emitting portion, the side end portions and the tubular portions are not coated with the light-shielding film.

2. The light-emitting container for a high intensity discharge lamp of claim 1, wherein a thickness of the central light-emitting portion is 0.3 mm to 1.5 mm, a thickness of the thick portion is 0.5 mm to 5.0 mm, and the thickness of the thick portion is 1.1 times or higher than the thickness of the central light-emitting portion.
3. The light-emitting container for a high intensity discharge lamp of claim 1 or 2, wherein the light-shielding film comprises a cermet of a refractory metal and ceramics, and wherein a thickness of the light-shielding film is 3 to 10 μm .
4. The light-emitting container for a high intensity discharge lamp of any one of claims 1 to 3, wherein the light-shielding film coats 20% or more and 95% or less of a total of surface areas of outer surfaces of the central light-emitting portion, the thick portions and step surfaces between the central light-emitting portion and the thick portions.

Fig. 1

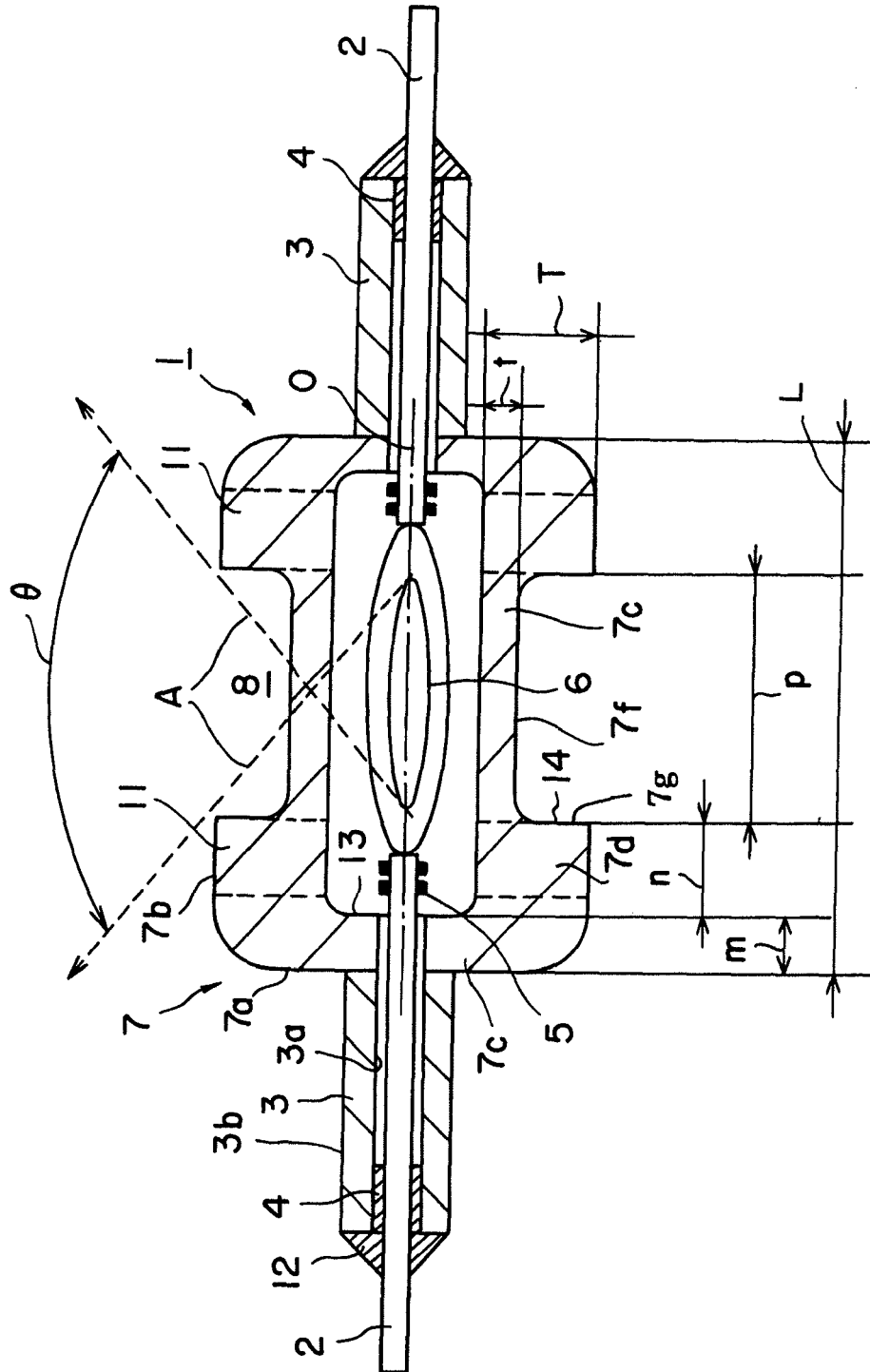
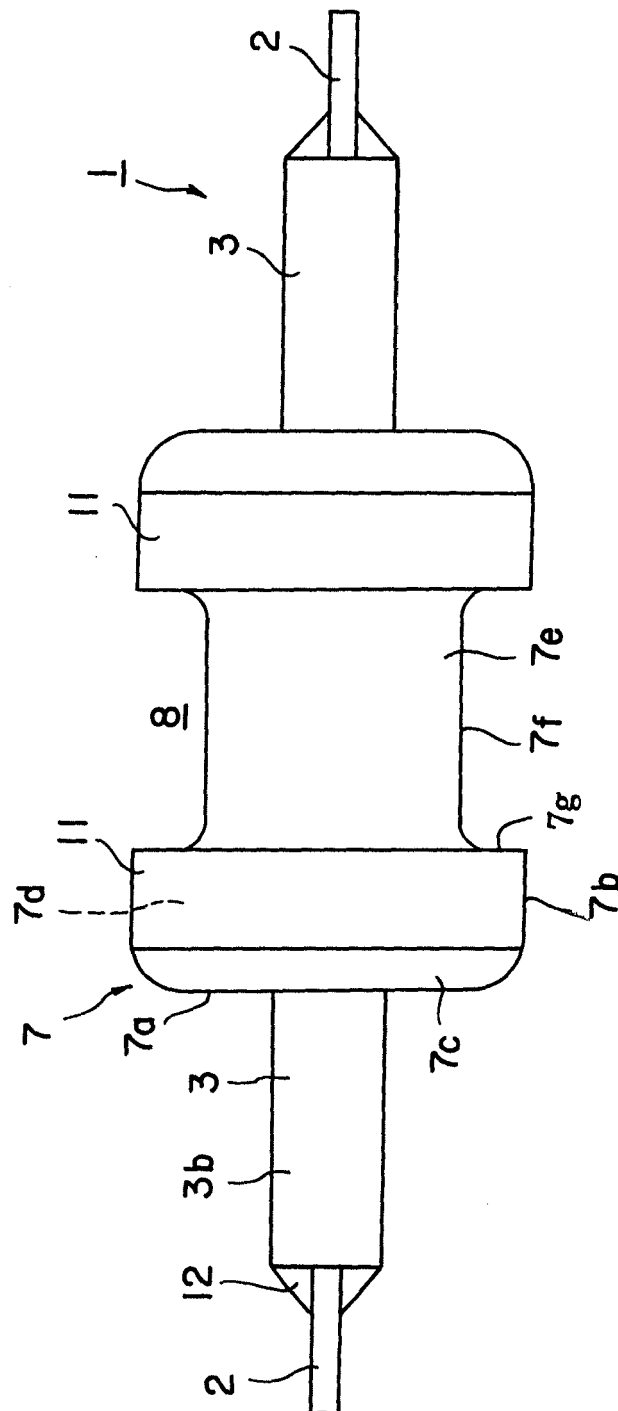


Fig. 2





EUROPEAN SEARCH REPORT

Application Number
EP 09 16 9339

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2004/023517 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; WIJENBERG CHRISTOFFEL [NL]; HENDR) 18 March 2004 (2004-03-18) * page 3, line 3 - line 8; figure 2 * -----	1-4	INV. H01J61/30 H01J61/86 H01J61/35
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 March 2010	Examiner Zuccatti, Stefano
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 16 9339

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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